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UNITED STATES DEPARTMENT OF AGRICULTURE

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

Project	Date	Author

TITLE

A PRELIMINARY STUDY OF THE TRAPPING OF THE WESTERN PINE BEETLE IN SAW LOGS AT THE BLACK'S MOUNTAIN EXPERIMENTAL FOREST

JMM
MLL
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ESB

By
J. W. Johnson
Berkeley, California
May 19, 1942

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SUBJECT—

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Copies sent to –

Craighead
Keen
Evenden
R. O.
Experiment Station

BUREAU OF Entomology and Plant Quarantine
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BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

WASHINGTON, D. C.

June 8, 1942

For JMM

To: J. M. Miller, 335 Giannini Hall, U. C., Berkeley, California

From: F. C. Craighead, in Charge, Forest Insect Inv.

Subject: Trapping Western Pine Beetle in Saw Logs

We have Johnson's report entitled Trapping Western Pine Beetle in Saw Logs, submitted with Struble's memorandum of May 20.

This is an interesting study and the results attained appear to support earlier work on the controlling effect of logging operations. Apparently we can't hope for much control from this source except under very special conditions.

FCC

428.a 32

with report

341 Giannini Hall, U. C.
Berkeley, California

May 20, 1942

To: F. C. Craighead, In Charge, Forest Insect Investigations

From: G. R. Struble, Acting for J. M. Miller, In Charge, Berkeley Laboratory

Subject: Trapping Western Pine Beetle in Saw Logs

Submitted herewith is a preliminary report by J. W. Johnson on some observations made at Black's Mountain Experimental Forest in 1941. It is evident from the limited amount of information obtained that the adult western pine beetle population trapped by saw logs is rather small. Consequently there may not be an appreciable reduction in infestation as a result of such trapping. Johnson's interpretation of the data seems quite adequate. We will welcome any comments you have to offer on this report. Copies are also being sent to Keen and Evenden.

Enclosure

GRStruble:LW

cc: Keen
Evenden

Forest Insect Laboratory
Berkeley, California
May 19, 1942

A PRELIMINARY STUDY OF THE TRAPPING OF THE WESTERN PINE BEETLE IN SAN LUIS AT THE BLACK'S MOUNTAIN EXPERIMENTAL FOREST

APPROVED BY:

J. M. MILLER
Senior Entomologist, in Charge

SUBMITTED BY:

J. W. JOHNSON
Junior Entomologist

A PRELIMINARY STUDY OF THE TRAPPING OF THE WESTERN PINE BEETLE IN SAW LOGS AT THE BLACK'S MOUNTAIN EXPERIMENTAL FOREST

The attraction of the western pine beetle to green logs of ponderosa pine has been investigated by a number of workers during the past 20 years. Studies have been made of the success of beetles in trap logs (7), of the trapping influence and effects of whole trees in highway slash (8), of the possibilities of controlling subsequent infestations in areas treated by direct control methods through the use of lines of trap logs placed around the edges of such areas (3 and 4), and finally of the amount of beetle removal that occurs in ponderosa pine commercial logging operations (1). The results of this work have greatly increased knowledge of the behavior of the western pine beetle towards green ponderosa pine logs and of the potentialities of such logs for removing beetle populations. While it has been shown that the density of attacks and the success of the broods in such logs generally is less than in standing trees, and that the use of green logs for purposes of absorbing beetle populations during direct control operations is impractical, it has been found also that the removal of green logs during commercial logging operations carries out of the woods large numbers of beetles, resulting in a heavy drain upon the beetle populations of the immediate cutting area and of the forest there adjoining. Under these circumstances the removal of saw logs is a factor contributing to the reduction of beetle populations in particular areas.

For the past 5 years the selective removal of trees as an indirect control measure of pine beetle losses has been in progress at the Black's Mountain Experimental Forest. The objective of this sanitation-salvage treatment has been the reduction of insect losses subsequent to cutting. In considering the reductions in losses which have been secured by this means, questions concerning the trapping effect of the green logs under conditions of this type of control have suggested themselves. A need has been felt for some information on the extent to which the logs removed by the sanitation-salvage treatment have absorbed and carried beetles from the treated areas. If the amount of trapping should prove to be as large as that found in other studies, it might introduce another factor contributing to the reductions in losses that have been observed, and secondly, it might indicate the possibilities for further increasing reductions of subsequent losses through the judicious coordination of the felling and yarding activities of the logging project.

Because of the promptness with which logs usually are removed from the experimental forest, it has been assumed that the trapping effect of the logs probably has been small or negligible. Where logs have lain in the field overwinter, however, there has existed a possibility of numbers of beetles entering them during warm periods in late autumn and early spring. As no actual observations had been made of the degree to which logs removed beetle populations from the experimentally treated areas, some attention was given to this problem in the summer of 1941. It was believed that observations made in this season would be particularly informative since about 100,000 board feet of logs had lain in the field over the previous winter.

OBJECTIVES

Work on the problem was directed towards these objectives:

1. To determine the extent to which green logs served as traps for bark beetles before removal to the mill.

2. To determine if the beetles selected logs for attack according to the previous risk of the tree.

3. To form some estimate of the possible influence of the trapping upon beetle populations in the affected areas, and of the potentialities of the green logs for effecting greater reductions in beetle numbers.

In addition attention was to be given to the occurrence of blue stain, which is a hazard associated with the attacks of the bark beetles.

SCOPE

The work that was undertaken was limited in its scope. It consisted of making a series of observations on logs, and estimating the degree of their infestation by bark beetles at the time of their removal from the woods. In this way it was believed possible to determine whether logs were regularly high infested, or conversely, whether they usually contained no or very few attacks. Such rough data would be of definite value in indicating the extent to which the logs were trapping bark beetles, and for estimating the possible influence of the log removal upon the beetle populations in the treated areas.

PROCEDURE

Observations were made on the logs at the loading landing. The examination consisted of exposing the phloem with an axe at intervals of 5 to 10 feet along the logs on as many surfaces as were accessible, noting the conditions of infestation, the species of insects, the life stages present, and rating the intensity of the infestations. The infestations were rated as absent, as composed of few and scattered attacks, or as more general infestations of light, moderate, and heavy intensities. The logs usually bore the number of the tree from which they were taken. By referring with this to other records, it was possible to determine their origin and the date when the tree was cut. Field examinations were begun on June 2, 1941, and continued at intervals of 1 to 2 weeks throughout July. In later July and thereafter log removal in general was carried out promptly. Because of this, after an examination of a seventh and final series on August 20, the study was discontinued for the season. During the two and one-half month period observations were made on several hundred logs from 131 trees, 128 ponderosa and 3 Jeffrey pines. This number amounted to about 9 percent of the total number of trees removed from the area in the interval covered by the study. The areas from which logs were drawn included forestry plots on which trees of all risks were cut, and forest compartments treated by sanitation-salvage methods from which only high risk trees were removed.

OBSERVATIONS

General conditions of infestation in the logs

Of the 125 ponderosa pine trees from which logs were sampled, 84, or 66 percent, gave no evidence of attacks. In logs of the remaining trees attacks of one or more insect species were found. Most of these contained 1 or 2 to 5 or 7 entrance galleries scattered along the boles. Such attacks would be of little significance as a factor in beetle removal. Logs of only 14, or 11 percent, of the trees were found to have more general infestations, which, with but one exception, were all attacks of Dendroctonus brevicomis Lec. The exception was one log which had lain overwinter. It was found to be moderately infested with Dendroctonus valens Lec. In the logs with general infestations, the actual extent of the attacks usually was found to be restricted to one side or one quadrant only of the log cylinder, but extending the length of the log. Thus even in so-called heavily infested logs perhaps but one-half or one-third of the total phloem area available for beetle removal was being utilized.

Species involved in the attacks

Four species of bark beetles were found attacking the logs. Of these Dendroctonus brevicomis and Dendroctonus valens were the only two species which had a notable frequency. Isolated attacks of Ips oregoni (Mich.) and four attacks of Ips emarginatus (Lec.) were found also.

Dendroctonus brevicomis with but one exception was the only species that developed general infestations in logs. All such infestations were in trees cut during 1941 summer. None of the logs that had lain over winter became infested by D. brevicomis, and the logs probably were removed from the field before any considerable flight of the species had taken place in the new season.

Dendroctonus valens was found commonly in scattered attacks in logs during the earlier part of the season, especially in logs that had lain over winter in the field. One of these had a moderate infestation all along its lower side.

Life stages in the logs

The Dendroctonus brevicomis infestations that affected the general surface of logs showed egg galleries and eggs. In logs where attacks were scattered and new, only parent adults were found. The Dendroctonus valens attacks in overwintering logs showed parent adults and eggs. In the occasional attacks found during the summer only parent adults were present. Ips attacks of both species showed parent adults only.

Blue stain

Severe blue-staining in association with Dendroctonus brevicomis infestations was found in several logs. Unfortunately records of all but one of these were not useable. The one observation retained in the record was that of a

tree felled June 24 and examined 32 days later on July 26. Sufficient time had elapsed following infestation to allow blue stain to develop. Other logs infested by D. brevicomis while exposed to the danger of blue stain, were removed before staining became evident.

Relation of occurrence of attacks to length of time the logs lay in the field

No infestations of a general character were found in logs less than 12 days old. The occurrence of infestations in logs of greater age was irregular. While the 12-day minimum for general infestations of the logs may be a result of coincidence between the time of felling, of infestation, and of log examination, it agrees with Beal's (1) observations that the percentage of bark infested on logs undergoes its greatest increase between 5 to 10 days or 2 weeks after cutting. After this time the area of infested bark increases at a much lower rate.

Relation between date of cutting, date of observation, and beetle activity

No logs with general D. brevicomis infestations were found until after the June 27 examination. Also, no logs that were cut after July 8 showed such infestations. It would appear that there was a period at the end of June or in the first week of July when D. brevicomis was active in attacking trees. Trees cut and removed before the first of July appear to have exerted no trapping influence, not those which were cut after July 8 and up to the end of the observations. The period of beetle activity indicated by the data coincides with the termination of cold, wet, spring weather on June 30, 1941, and the onset of warm weather on July 1.

The group of logs showing general infestations all were drawn from one area in which the infestation of the previous year was high. It is unfortunate that no logs were on the ground at the same time in areas where populations of the previous season had been low. Comparisons of results under such circumstances might have furnished some information on the extent to which the beetles were moving about in seeking suitable host material.

Relation of occurrence of infestations to previous risk ratings of the trees

As a matter of interest the logs with general D. brevicomis infestations were distributed into the four Risk classes in accordance with the previous risk ratings of the trees. In the same way all trees that were examined in July from the same area as the infested trees were distributed by their previous risk classes. The results are shown below:

Log Infestation in Relation to Previous Risk Ratings

Data	Risk 1	Risk 2	Risk 3	Risk 4	Total
Total No. Trees	17	16	12	8	53
Total Inf. Trees	4	4	4	1	13
% Infestation	23.5	25.0	33.3	12.5	24.5

While the sample probably is too small to allow any conclusion to be drawn, no particularly one-sided distribution of the attacks with respect to previous risk ratings of the trees is shown.

DISCUSSION

From a consideration of the records that were obtained, it is evident that while the data do not offer much basis for an extended analysis of factors and effects, it provides some observations of value for the problem being considered. These observations taken in conjunction with the results of earlier studies make it possible to estimate the factors that seem important in favoring trapping and the influence which they may have exerted in the past season.

Beetle populations

The first group of factors in the problem of trapping beetles and their removal from the forest are the beetle populations. Their presence and density, the length and number of periods during which the populations are in a state favorable for infesting logs, the extent to which they move from areas of high concentration to areas of low concentration, the extent to which they are attracted by logs, the time required to find and to infest logs, and the manner in which they infest the logs are all elements of importance in determining whether or not much trapping occurs. In this respect the summer of 1941 proved to be somewhat unsatisfactory for making observations. Beetle populations were at their lowest point since records were begun on the experimental area.

With respect to the seasonal activity of the beetle populations, the data taken in the past summer of 1941 suggest that there existed a period of flight and attack during which logs were infested. This period, however, was preceded and followed by long intervals of time when no trapping occurred. Under these conditions populations may have been removed from some areas, while from others no removal took place. These circumstances would make it difficult to determine for which areas allowance should be made for insect removal in evaluating effectiveness of cutting. Results of earlier studies have shown that variation in the intensities of infestation occur during the course of the season of activity, but none have shown such definite limitation of the period of attack as was found in 1941. This phenomenon may have been the result of the restraining effect of the weather in early summer coupled with a low population level.

The mobility of beetle populations has been well demonstrated by the San Joaquin trapping and flight studies (3-6), and the Devil's Garden Extermination Project (9). Since these studies have shown that heavy beetle flights may take place over distances of two or more miles, lack of mobility would not appear to be a factor leading to irregular distribution of attacks on logs during the season. This great capacity for dispersal would also tend to make possible rapid replacement of populations lost from areas during logging operations. In the 1924 Forked Meadows study of the San Joaquin Project replacement of beetles was so rapid on an area that was given continuous intensive direct control treatment that losses during the season were twice as high in the area as they had been during a season of direct control in the previous year (3).

With respect to the time required for finding and infesting logs, it is believed that no certain evidence is offered by the observations of the past summer. The fact that all infestations appear to have taken place during one brief interval suggests that the time may be short when other conditions are favorable, and this is confirmed by other studies of the attraction of logs for beetles. These have shown that beetles will attack logs within 24 hours after cutting. The manner in which beetles infested logs in the past summer - their tendency to fill up one side of a log only - has been shown by Beal probably to be the result of a temperature response of the organisms. This circumstance may reduce the efficiency of logs in removing insects, especially if limited numbers of logs are on the ground during periods favorable for attack. The unequal distribution has further significance in problems of detecting infested logs, and properly sampling and estimating the amount of infested material being removed.

Logs and logging practices

The second group of factors in the trapping of the beetles are the logs and the logging practices. The time of the season when logs are felled, the coincidence of log presence with beetle flights, the speed with which logs are removed from the woods, their distribution over the area with respect to centers of high and low populations all may be considered to exercise, and have been shown to exercise, an influence on the ultimate number of beetles absorbed in the logs. In the past season trees cut late in 1940 and overwintered on the ground showed no D. brevicomis infestations. Such infestations occurred only in the trees felled during the summer. Observations seemed to indicate that the only logs exerting a noticeable trapping effect were a particular group that were on the ground during a period of beetle flight and attack. In the past summer, also, the prompt removal of logs over much of the season probably reduced the opportunities for their infestation.

Estimation of trapping in 1941

With the consideration of the factors affecting the absorption of beetles in logs in mind it may be possible to form some estimate of the amount of trapping that occurred in the 1941 field season. One method that could be used would be the application of the percentage of infestation in the sample to the total number of trees removed during the season. About 11 percent of those that were examined contained infestations of "light", "medium", or "heavy" intensities. Applying this percentage to the approximate total of 2,000 ponderosa pines removed during the season, one may derive a theoretical number of 220 infested trees removed. In view of the reduced infestation in the virgin forest, which may be estimated as not likely to exceed 250 infested trees on an area five times the size of that which was cut over in the same season, it would appear that the estimated 220 infested trees is much too high.

Comparing this estimate with the observed limited period of attack in July and the practice of speedy log removal in later summer, it would seem that the bulk of the logs removed up to the end of the observations probably were unexposed to such infestations. Following the termination on August 20

of the special log examinations, much other work was performed on green logs until the end of the field season. In no case were further infestations of logs observed. This suggests that of all areas treated during the season, but the one on which logs were lying at the time of beetle flight in July suffered a loss of many beetles in infested logs.

The area from which infested logs were drawn was Compartment P 23-31 and perhaps part of Compartment P 20-32. Approximately 500 trees were removed from these compartments, but the percentage that were cut before July 8 is not known. Not all of the trees that were removed would appear to have been on the ground at the time of maximum D. brevicomis attack. Of the 53 trees examined from this area 22 were cut after July 8. The remaining 31 trees cut before this time provided the 13 infested trees that were found. This represents a 42 percent infestation frequency in the trees felled earlier in the season on the area, and may indicate that a considerable amount of trapping and the removal of a considerable population of beetles actually took place in the area embraced by the two compartments. However, the effect of such a large removal of beetles from the area upon population levels later in the season or in the following year is in doubt. Experience in the San Joaquin Project indicates that removal of beetles from small blocks of timber surrounded by untreated forest has little influence on the course of subsequent infestations on the treated areas.

Consideration of the data gathered in 1941, then, would seem to suggest that little or no trapping took place on most treated areas. On one area embracing parts of two compartments, P 23-31 and P 20-32, a considerable loss of beetle populations may have taken place, but the ultimate effect of this beetle removal on subsequent losses of the area probably will be inconsiderable.

Use of controlled logging schedules for increasing beetle absorption and removal in green logs

The number of observations of the 1941 season appear too few to permit any recommendation for or against the possibilities of using a controlled log removal program as a means of securing greater absorption of beetles before the green logs were moved to the mills. Results from Beal's study in Oregon showed that in the two seasons during which it was carried on 51 percent of the logs were infested, and these had an average age of two weeks. The percentage of infested bark area on such logs increased rapidly up to two weeks after felling, declining to a uniform rate of increase thereafter. This suggests that a planned program of holding logs in the field for a period of two weeks before their removal would achieve maximum efficiency in beetle absorption for the period of time involved. In such work the hazard of blue stain must always be taken into consideration. The record of the blue-stained tree in 1941 shows this tree to have lain in the woods probably three weeks after it was infested, and indicates a possible limit to the time infested logs should be allowed to lie in the woods in mid summer. Beal suggests "It does not appear necessary or especially advantageous to leave logs in the woods for longer than about two or three weeks for the purpose of absorbing beetle attacks. During heavy flight periods and in the middle of the summer, when danger from blue-stain is greatest they may be removed from ten days to two weeks after falling, with considerable assurance of removing a great many beetles with them." (1, pp 12 and 13).

CONCLUSION AND SUMMARY

In the summer of 1941 a brief study was undertaken on the Black's Mountain Experimental Forest to determine roughly the extent to which green logs cut for saw timber during sanitation-salvage operations were trapping bark beetles before their removal from the woods. Over a period of about two and one-half months a 9 percent sample was made of all logs removed. Results of the sampling are presented, and factors that may affect the amount of trapping that took place are discussed. It would appear that the absorption of beetles in logs depends upon the favorable coincidence of many factors arising from the status and behavior of beetle populations and from logging activities. In 1941 little trapping is believed to have occurred on most of the areas treated by sanitation-salvage methods. It is possible that one area of about 194 acres experienced the removal of considerable numbers of beetles.

The following points may be noted:

1. Dendroctonus brevicomis Lec. was the only species producing general infestations in logs during the summer. Dendroctonus valens Lec. moderately infested one overwintering log and appeared occasionally in others which had overwintered or which were cut early in the summer season.

2. Logs on the ground only during a limited period in the first week in July showed infestations of D. brevicomis.

3. Blue stain was found in some logs. All trees that become infested are subject to the hazard of blue staining if not milled soon after beetle attack.

4. Infestations were uneven and one-sided in logs.

5. The trapping of considerable numbers of beetles in logs would seem to be dependent upon the fortunate coincidence of a number of distinct factors.

6. It is not believed that sufficient trapping actually occurred in 1941 on most areas treated by sanitation-salvage methods to markedly affect the beetle populations in these areas.

7. Observations of the 1941 season agree in general with those of previous studies on the trapping of beetles in green logs, with the exception of the very limited period of flight and attack that existed in the current season.

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Table 1. Summary of the Sources of Trees and Numbers of Observations

Source of Trees	Date of Cutting	Dates of Examination	No. Trees Removed	No. Trees Examined	% of Trees Examined
1940 Plot 4	October 1940	June 2, 1941 June 12,1941	200?	15	7.5
P 15-33	June 3-12, 1941	June 12, 1941 June 27, 1941	235	41	17.4
P 20-32) P 23-31) 1940 Plot 5) 1940 Plot 6)	May-July 1941	July 12, 1941 July 17, 1941 July 26, 1941	534 (approx)	55	10.3
P 18-27	July 1941	No examination	202	--	--
C 14-28	Aug. 6-12, 1941	Aug. 20, 1941	239	20	8.4
Totals			1,410	131	9.3

Table 2. Intensities of Attacks of all Beetle Species

	Unattacked	Scattered	Light	Moderate	Heavy	Total
Number of Trees	84	30	2	5	7	128
Percent of Total	65.6	23.4	1.6	3.9	5.5	100.0

Table 3. Occurrence of Insect Species in Felled Green Trees

Insect Species	Observ. Date	Number of Trees & Intensity of Infestation					Total Trees Examined
		Unsucc.	Scattered	Light	Moderate	Heavy	
	6 - 2-41	2					11
	6-12-41						23
	6-27-41		2				21
Db	7-12-41		1		2	3	15
	7-17-41			1	1	1	4
	7-26-41	1	2	1	1	3	34
	8-20-41		3				20
Db	All	3	8	2	4	7	128
	6-2-41		9		1		11
	6-12-41		5				23
	6-27-41		2				21
Dv	7-12-41		1				15
	7-17-41						4
	7-26-41		3				34
	8-20-41						20
Dv	All		20		1		128
Io	6-2-41		4				11
	6-27-41		1				22
Io	All		5				128
Ie	6-2-41		1				11
All	All	3	30	2	5	7	128

Table 4. Occurrence of Attacks in Relation to Log Age

	Elapsed time between falling and examination - days																									Over-Winter	Total
	1	2	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	21	22	23	31	32	33	58	60		
No. Trees	2	2	3	4	6	11	13	11	1	4	16	1	2	5	4	3	1	4	3	4	2	2	3	2	3	15	128
No.Inf.Tr.*											5			3							1	2	1	1		1	14

* Refers to trees with general infestations only.

Table 5. Infestations in Relation to Date of Cutting and Date of Observation

Examin. Date	Over Wint.	Dates of Cutting: May 27	June 3	4	5	6	9	10	11	12	23	24	25	30	July 1	2	8	10	11	15	16	17	18	21	22	August 6	7	8	11	12	Total Trees Exam.
June 2	1*																														11
June 12																															23
June 27																															21
July 12														5																	15
July 17															3																4
July 26		1									1	2	1																		34
Aug. 20																															20
Tot. Tr. Exam. for Each Date	15	3	2	6	14	10	1	3	4	2	3	2	2	7	4	3	1	2	2	1	1	5	8	4	3	2	1	9	5	3	128

* D. valens, the remainder of infestations are of D. brevicomis.